REMARKS

Claims 1-18 are rejected under 35 USC §103 as being unpatentable over Kagaku et al., JP 11-017217 in combination with either Sumi et al., US 6,194,818, Okutoh et al., US 6,201,271 or Won et al., US 6,416,584.

Independent claim 1 recites a method for increasing photoluminescence in Erbium Oxide thin films. The method includes the step of forming Erbium Oxide molecules by reacting Erbium sputtered atoms with O_2 in a gas phase. The method also includes the step of creating the Erbium Oxide thin films by depositing the Erbium Oxide molecules on a substrate coated with Silicon Oxide. The method further includes the step of annealing the Erbium Oxide thin films by utilizing a low temperature treatment for a specified amount of time and temperature followed by a high temperature treatment for another specified amount of time and temperature, wherein the temperature treatments increases crystallinity of the thin film.

Independent claim 10 recites a process for increasing the photoluminescence of Erbium Oxide thin films is provided. The process includes the step of forming Erbium Oxide molecules by reacting Erbium sputtered atoms with O_2 in a gas phase. The process also includes the step of creating the Erbium Oxide thin films by depositing the Erbium Oxide molecules on a substrate coated with Silicon Oxide. The process further includes the step of annealing the Erbium Oxide thin films by utilizing a low temperature treatment for a specified amount of time and temperature followed by a high temperature treatment for another specified amount of time and temperature, wherein the temperature treatments increases crystallinity of the thin film.

Kagaku et al. '217 describes forming multiple pores in a single crystal Si, polycrystalline Si, or non-crystalline Si substrate, by electro-chemical etching or mesa etching using mask

pattern. Rare earth metals oxides, such as Er_2O_3, are adhered on the porous Si substrate by sputtering. By annealing, the porous substrate is polycrystallized.

Sumi et al. '818 describes a mechanism that can eliminate an influence of residual strain in a piezoelectric thin film, having excellent piezoelectric strain characteristics. No or few foreign substances exist or an abundance of foreign substances is low at grain boundaries, which are boundaries between crystal grains of the piezoelectric thin film, even after performing polarization processing (poling) on the piezoelectric thin film component. The width of the grain boundary is 5 nm or less. The crystal grain boundary is a discontinuous layer, which does not continue the orientation of adjacent crystal grains.

Okutoh et al. '271 describes an alloy oxide film of platinum and rhodium that is formed as an upper electrode so as to be put in direct contact with a ferroelectric PZT film. Asymmetry of a hysteresis loop characteristic of a dielectric material representing a correlation between a polarization value and an application electric field as well as a deterioration such as an increase in leak current density, when oxide electrodes of IrO_2, RuO_2, RhO_2 or the like is used, are improved.

Won et al. '584 describes an apparatus for forming a film on a substrate that includes a reaction chamber and gas supply lines. The gas supply lines supply gases for depositing and annealing the film. Depositing a dielectric film and annealing the dielectric film are performed in situ using the reaction chamber. Thus, the time required for forming the dielectric film is shortened, improving the productivity. Also, deposition and annealing of the dielectric film are performed in the same reaction chamber, so that less area is required for manufacturing equipment.

While Kagaku et al. '217 describes depositing Erbium Oxide on a Si substrate, it will be appreciated that claims 1 and 10 recite that the Erbium Oxide is deposited on a substrate that is coated with silicon oxide. Kagaku et al. '217 does not teach or suggest a substrate that is coated with silicon dioxide, but instead shows Erbium Oxide directly deposited or sputtered on the Si substrate. Moreover, Kagaku et al. '217 does not address the process of annealing as recited in claims 1 and 10. Therefore, Kagaku et al. '217 does not teach or suggest the invention as claimed.

Sumi et al. '818 describes a two-step annealing process, however, it focuses primarily on forming PZT films or a porous gel thin film of PZT. The chemical composition of PZT is quite different from Erbium Oxide. Moreover, Sumi et al. '818 describes a PZT thin film component including a silicon oxide film formed on the silicon substrate, a titanium film formed on the silicon oxide film, a bottom electrode formed on the titanium oxide film, a PZT film formed on the bottom electrode, and a top electrode formed on the PZT film.

Claims 1 and 10 recite that the Erbium Oxide molecules are deposited on a substrate coated with Silicon Oxide. The PZT film that is being crystallized using Sumi et al. '818's two-step annealing process is deposited on the bottom electrode, and not on a substrate coated with silicon oxide. Furthermore, Sumi et al. '818 states that the PZT film is comprised of polycrystalline substance, and the grain boundaries of the crystal grains exist in vertical direction with respect to the planes of the top and bottom electrodes. This clearly supports the conclusion that the PZT film is not formed on a substrate coated with silicon oxide. Given that Kagaku et al. '217 describes the use of Erbium Oxide and Sumi et al. '818 describes the formation of PZT films, the combination of these references will not render obvious claims 1 and 10.

Okutoh et al. '271 describes forming a SBT ($SrBr_2Ta_2O_9$) film using various annealing steps. The SBT film is coated on a lower electrode, which comprises platinum. The Examiner's rejection suggests that the fact that the SBR film is crystallized and the techniques used satisfy a showing of the first and second annealing steps recited in claims 1 and 10. Applicants respectfully disagree with the Examiner on this point.

First, the chemical composition of SBT is quite different from that of Erbium Oxide, and thus have different properties. Secondly, claims 1 and 10 recite that Erbium Oxide molecules are deposited on a substrate coated with silicon oxide. There is no teaching or suggestion in the reference that the SBT molecules were deposited or sputtered on a substrate coated with silicon oxide. Instead, the lower electrode, which comprises platinum, is coated with SBT not silicon oxide. Given that Kagaku et al. '217 describes the use of Erbium Oxide and Okutoh et al. '271 describes the formation of SBT films, the combination of these references will not render obvious claims 1 and 10.

Won et al. '584 states that a dielectric film is deposited on a lower electrode of a capacitor, which is formed on a semiconductor substrate. The material of the dielectric film is selected from a group consisting of a tantalum oxide (e.g., Ta_2O_5), a titanium oxide (e.g., TiO_2), an aluminum oxide (e.g., Al_2O_3), an yttrium oxide, a vanadium oxide and a niobium oxide. Note the discussion for FIGs. 6-8 recite forming the dielectric film on a semiconductor substrate. However, there is no discussion whether the semiconductor substrate is coated with silicon oxide as recited in claims 1 and 10. Also, the dielectric film material does not include Erbium Oxide. Given that Kagaku et al. '217 describes the use of Erbium Oxide and Won et al. '584 describes

the formation of films that do not include Erbium Oxide, the combination of these references will not render obvious claims 1 and 10.

Furthermore, the SiO_2 underlayer is required for proper formation of Er_2O_3 and strong adhesion of the Er_2O_3 layer to the substrate material. Without the SiO_2, it is found that the Er_2O_3 exhibited additional defects which caused reduction of luminescence by the film. In any other prior work stating deposition on a bare Si surface, there may be a native oxide layer which is a nanometer thick. However, it is found that native oxides lacked the thickness necessary for sufficient adhesion. In the prior works, if the bare Si surfaces were bathed in plasmas, the native oxide would have probably been stripped. On bare Si, it is found that Er_2O_3 luminescence was poor due again to defects stemming from poor film adhesion. Note that without the presence of the oxide (and even in the case where a native oxide is present), the Er_2O_3 did not show as much luminescence as when a thick oxide is present.

In view of the above amendments and for all the reasons set forth above, the Examiner is respectfully requested to reconsider and withdraw the rejections made under 35 U.S.C. §103. Accordingly, an early indication of allowability is respectfully requested.

If the Examiner has any questions regarding matters pending in this application, please feel free to contact the undersigned below.

Respectfully submitted,

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